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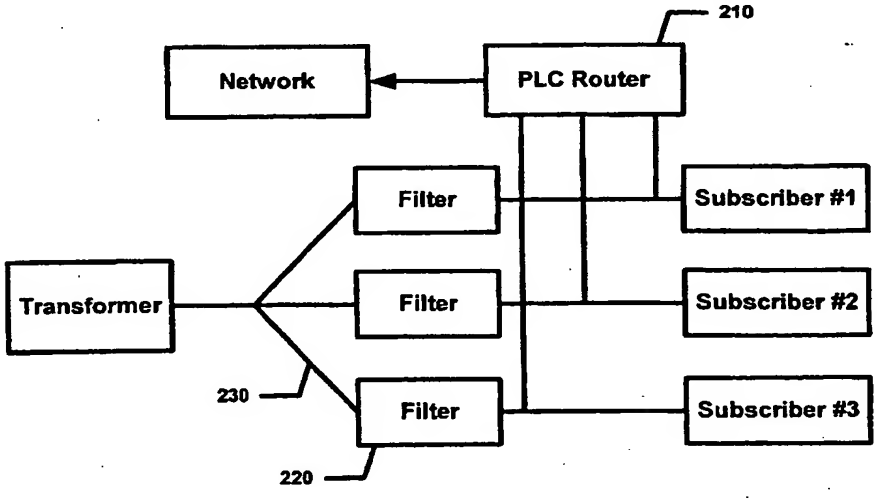
(54) Title: METHOD OF ISOLATING DATA IN A POWER LINE COMMUNICATION NETWORK



(57) Abstract: Isolating data in a power line communications system. Although plural subscribers receive electric power distributed from a common distribution transformer, it is desirable to isolate their branch lines from one another when those branch lines are used to conduct data communications as a supplement to electric power delivery. This isolation of branch lines is implemented in a centralized way at the distribution transformer, or alternatively, in a distributed way at each subscriber's premises. These implementations are made using low pass filters (which pass the power but block the data) and power line communications routers or power line communications repeaters.

WO 01/54297 A1

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METHOD OF ISOLATING DATA IN A POWER LINE COMMUNICATION NETWORK

INTRODUCTION

1. The present invention relates generally to the field of electrical communications via power lines. More particularly, the present invention relates to isolating data in a power line communications system.

BACKGROUND OF THE INVENTION

2. A typical electric distribution configuration has a transformer which steps medium voltage down to a few hundred volts AC (typically between 100 and 240 VAC). The Low Voltage (LV) is fed to several homes.

3. Referring to **Fig. 1**, the typical electric power distribution architecture is illustrated. No filter or other barrier is employed to isolate data from one residence to the next. Using this architecture for a power line communications system, typically a power line signal containing the data will be fed at the transformer. There are four potential problems with this topology for communications.

4. First, the bandwidth is shared between plural subscribers. Second, noise from another subscriber using a different type of power line communication system or noise from another subscriber's appliances may cause interference. Third, subscribers using the same system can interact with each other. Fourth, since one subscriber receives the other subscriber's data, there is a lack of security.

5. Thus, what is needed is a way of isolating data from subscriber to subscriber to alleviate the problems discussed above.

SUMMARY OF THE INVENTION

6. It is an object of the present invention to enable isolation of data from subscriber to subscriber.

7. It is another object of the present invention to enable isolation of data from a subscriber to the distribution transformer.

8. Isolation structures to realize these objects are implemented in a centralized way at the distribution transformer, or alternatively, in a distributed way at each subscriber's premises. These implementations are made using low pass filters (which pass the power but block the data) and power line communications routers or power line communications repeaters.

BRIEF DESCRIPTION OF THE DRAWING

9. Additional objects and advantages of the present invention will be apparent in the following detailed description read in conjunction with the accompanying drawing figures.

10. **Fig. 1** illustrates a conceptual view of a typical electric distribution topology.

11. **Fig. 2** illustrates a block diagram view of centralized data isolation.

12. **Fig. 3** illustrates a block diagram view of an embodiment of the present invention having isolation before the power meter.

13. **Fig. 4** illustrates a block diagram view of an embodiment of the present invention having isolation after the power meter.

14. **Fig. 5** illustrates a block diagram view of an embodiment of the present invention having isolation bridging the power meter.

15. **Fig. 6** illustrates a block diagram view of an embodiment of the present invention having a LAN only topology with a filter before the meter.

16. **Fig. 7** illustrates a block diagram view of an embodiment of the present invention having a LAN only topology with a filter after the meter

DETAILED DESCRIPTION OF THE INVENTION

17. According to alternate embodiments, data isolation is accomplished in a centralized manner, in a distributed manner (i.e., at the subscriber), or in a hybrid manner that is a combination of centralized and distributed.

18. According to one aspect of the invention, a system provides for network communications isolation in a branch line connecting a subscriber device at a subscriber premises to a network. The system includes an electric power distribution transformer, a branch line (connected between the transformer and the subscriber's premises), a low pass

filter, and a power line communications router. The low pass filter connected in the branch line at a location adjacent the transformer. The power line communications router is connected to the network and coupled to the branch line at a location adjacent the filter, on the subscriber side of the filter. When the subscriber device is coupled to the branch line, the subscriber device is coupled to the network and is isolated from the transformer by the filter.

19. According to another aspect of the invention a network coupler. The network coupler provides network communications isolation in a branch line connected to a subscriber premises through an electric power meter. The network coupler includes a low pass filter and a power line communications repeater. The low pass filter is coupled to the branch line adjacent to the power meter. The power line communications repeater is connected to the branch line across the low pass filter.

20. On the one hand, the power line communications repeater is connected across both the low pass filter and the power meter. In the alternative, the power line communications repeater is connected across only the low pass filter. The low pass filter is disposed either on the subscriber side of the power meter, or on the transformer side of the power meter.

21. According to yet another aspect of the present invention, a network isolator provides network communications isolation in a branch line connected to a subscriber premises through an electric power meter. The isolation is provided between a network located at the subscriber premises a transformer connected to the branch line. The network isolator includes a low pass filter. The low pass filter is coupled to the branch line adjacent to the power meter. The low pass filter is disposed either on the subscriber side of the power meter, or on the transformer side of the power meter.

22. Referring to **Fig. 2**, a centralized power line communications (PLC) router **210** is illustrated. The centralized PLC router **210** is connected separately to each branch line, which in turn connects to the subscriber. A filter **220** passes the high power electricity (100 VAC to 240 VAC) but blocks the power line communications signal. This filter **220** is implemented using electronic components such as inductors, capacitors and resistors. This method requires splicing the electric power line and inserting the filter **210** in series with the line **230**.

23. A less expensive way of implementing this filter, which does not require cutting the power line, uses a ferrite toroid as a common-mode choke. This is done by simply feeding an electric power line through a toroid, thus allowing the electric power (50-60Hz) to pass yet blocking the higher frequency signals that contain the power line communications data. In most situations the toroid method is preferred.

24. In conjunction with the centralized method, or as an alternative, data is isolated using a distributed approach. In this approach a filter (such as described above) is placed at the subscriber's location. A power line data repeater, which regenerates the data, is connected in parallel with the filtering device. This topology addresses the noise, interference and security issues. However, the bandwidth is shared between each subscriber connected to the transformer.

25. Referring to **Fig. 3** a block diagram view of an embodiment of the present invention having isolation before the power meter **300** is illustrated. This is an implementation according to a distributed topology. A PLC repeater **310** and a filter **320** are connected in parallel with one another and in series with the power meter **300**. The power meter **300** is disposed between the subscriber's house **340** and the PLC repeater **310**.

26. Referring to **Fig. 4** a block diagram view of an embodiment of the present invention having isolation after the power meter **400** is illustrated. This is another implementation according to a distributed topology. A PLC repeater **410** and a filter **420** are connected in parallel with one another and in series with the power meter **400**. The PLC repeater **410** is disposed between the subscriber's house **440** and the power meter **400**.

27. Functionally, the differences between the distributed topology implementations illustrated in **Figs. 3 & 4** are insubstantial. However, depending on the deployment one may be easier to implement than the other.

28. Referring to **Fig. 5**, a block diagram view of an embodiment of the present invention having isolation bridging the power meter is illustrated. A filter **520** is connected in series with the power meter **500**, and that series combination is connected in parallel with a PLC repeater **510**.

29. Although the distributed topology of this embodiment is potentially difficult to deploy, it has certain performance advantages. Performance according to this embodiment is superior since the electric meter **500** presents some attenuation of the power line communication signals. Thus, in this topology the PLC repeater **510** repeats signals across the filter **520** and electric meter **500**. This achieves a better signal-to-noise ratio by avoiding the attenuation that would otherwise be introduced by the electric meter **500**.

30. Referring to **Figs. 6 & 7**, a filtering device is placed on the power line adjacent the subscriber's premises. This is useful in cases where an internal Local Area Network (LAN) exists within the premises and access to a Wide Area Network (WAN) in not required. This provides security for the LAN as well as reduces interference from the outside. It also isolates the LAN from the WAN in case a WAN is deployed. According to the embodiment illustrated in **Fig. 6**, the filter **610** and the electric meter **620** are connected in a serial with one another, with the filter **610** before the electric meter **620**. Alternatively, **Fig. 7** illustrates the filter **710** and the electric meter **720** as being connected in a serial with one another, with the filter **710** placed after the electric meter **720**. The arrangement according to both of these illustrated topologies functionally perform the same. However, depending on the deployment one may be easier to implement than the other.

31. The present invention has been described in terms of preferred embodiments, however, it will be appreciated that various modifications and improvements may be made to the described embodiments without departing from the scope of the invention.

WHAT IS CLAIMED IS:

1. A system for providing network communications isolation in a branch line connecting a subscriber device at a subscriber premises to a network, the system comprising:

an electric power distribution transformer;

a branch line connected between the transformer and the subscriber's premises;

a low pass filter connected in the branch line at a location adjacent the transformer;

a power line communications router connected to the network and coupled to the branch line at a location adjacent the filter, on the subscriber side of the filter;

wherein, when the subscriber device is coupled to the branch line, the subscriber device is coupled to the network and is isolated from the transformer by the filter.

2. A network coupler to provide network communications isolation in a branch line connected to a subscriber premises through an electric power meter, the network coupler comprising:

a low pass filter coupled to the branch line adjacent to the power meter; and

power line communications repeater connected to the branch line across the low pass filter.

3. The network coupler of claim 2, wherein the low pass filter is disposed on the subscriber side of the power meter.

4. The network coupler of claim 3, wherein the power line communications repeater is connected across both the low pass filter and the power meter.

5. The network coupler of claim 2, wherein the low pass filter is disposed on the transformer side of the power meter.

6. The network coupler of claim 5, wherein the power line communications repeater is connected across both the low pass filter and the power meter.

7. A network coupler to provide network communications isolation in a branch line connected to a subscriber premises through an electric power meter, the network coupler comprising:

a low pass filter coupled to the branch line adjacent to the power meter; and

power line communications repeater connected to the branch line across both the low pass filter and the power meter.

8. A network isolator to provide network communications isolation in a branch line connected to a subscriber premises through an electric power meter, the isolation being provided between a network located at the subscriber premises a transformer connected to the branch line, the network isolator comprising:

a low pass filter coupled to the branch line adjacent to the power meter, wherein the low pass filter is disposed on the subscriber side of the power meter.

9. A network isolator to provide network communications isolation in a branch line connected to a subscriber premises through an electric power meter, the isolation being provided between a network located at the subscriber premises a transformer connected to the branch line, the network isolator comprising:

a low pass filter coupled to the branch line adjacent to the power meter, wherein the low pass filter is disposed on the transformer side of the power meter.

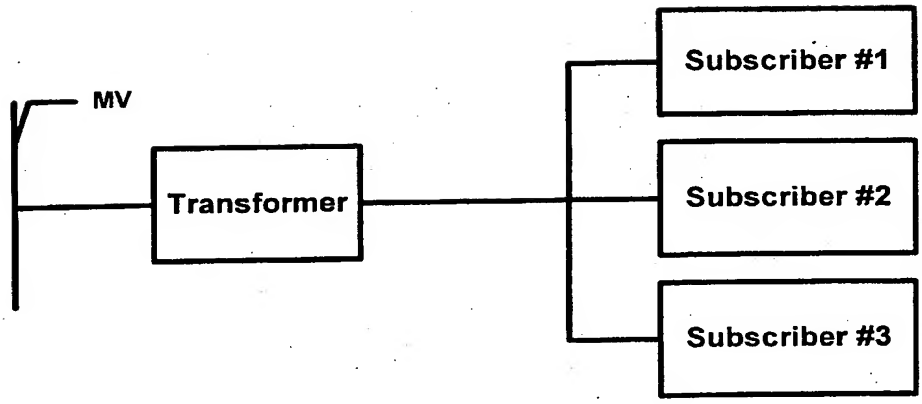

Figure 1

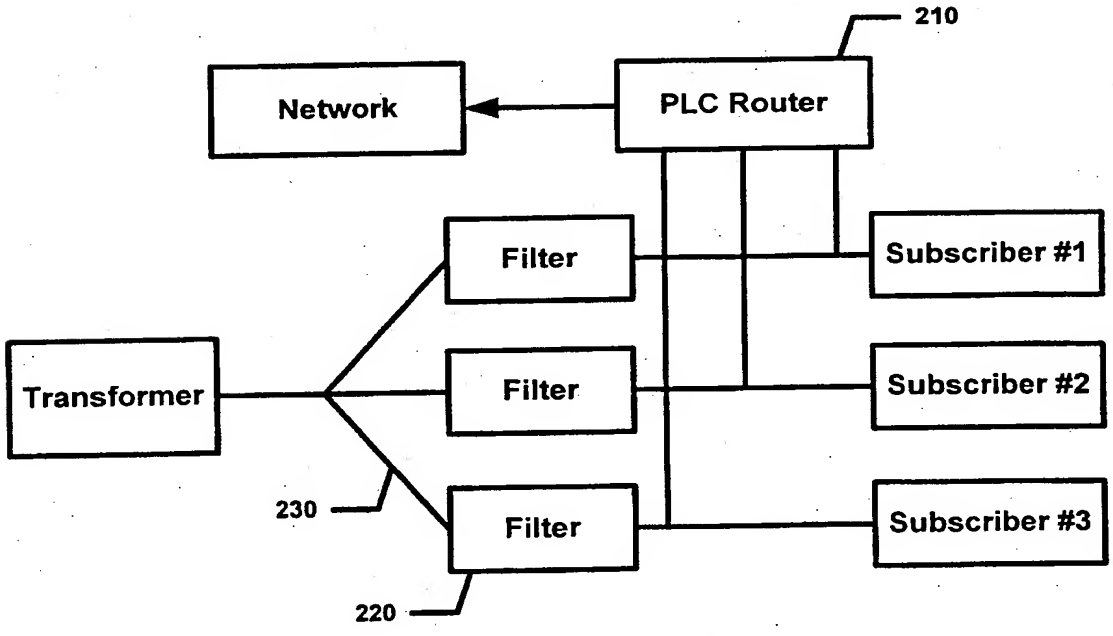

Figure 2

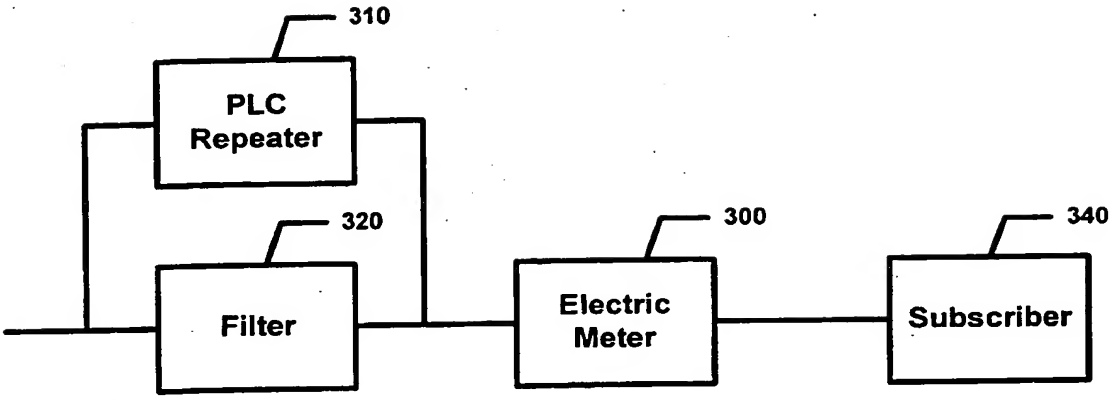

Figure 3

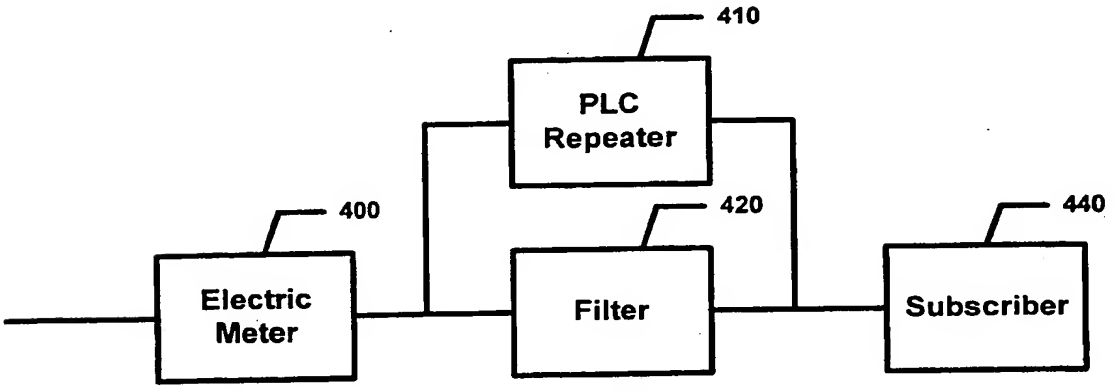

Figure 4

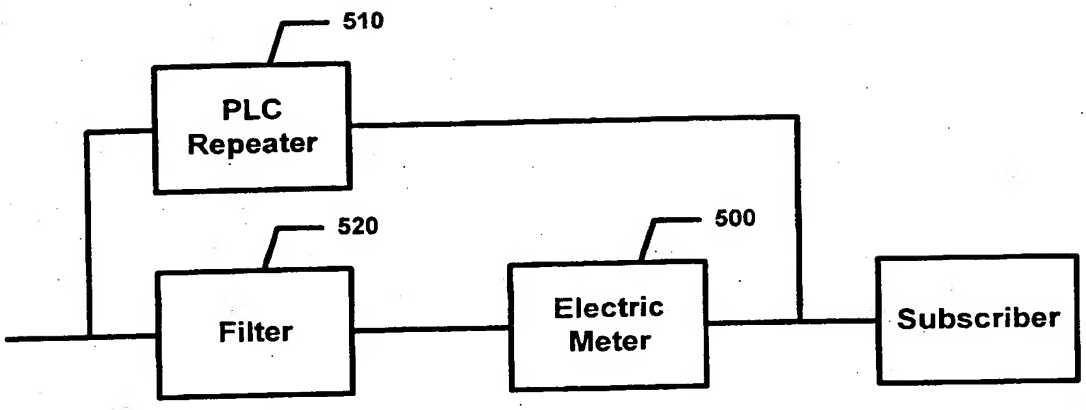

Figure 5

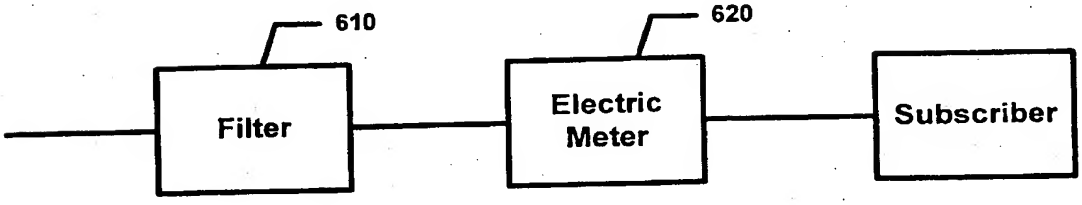

Figure 6

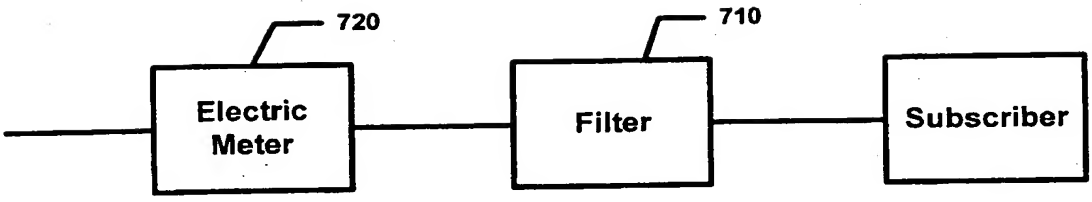

Figure 7

INTERNATIONAL SEARCH REPORT

Interr nal Application No
PCT/US 01/01810

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04B3/54

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, PAJ, WPI Data, INSPEC, COMPENDEX

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 98 33258 A (NORTHERN TELECOM LTD ;GREENWOOD JOHN CHRISTOPHER (GB)) 30 July 1998 (1998-07-30) page 6, line 4 - line 37 page 7, line 19 -page 8, line 2 page 8, line 18 - line 22 page 9, line 9 - line 23 ---	2-9
A	US 5 929 750 A (BROWN PAUL ANTHONY) 27 July 1999 (1999-07-27) column 2, line 32 - line 41 column 3, line 41 - line 57 column 4, line 6 - line 31 ---	1-9
A	US 3 911 415 A (WHYTE IAN A) 7 October 1975 (1975-10-07) column 3, line 5 -column 4, line 29 ---	1-9
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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
17 April 2001	02/05/2001

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	De Iulis, M

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INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/US 01/01810

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	PATENT ABSTRACTS OF JAPAN vol. 1998, no. 12, 31 October 1998 (1998-10-31) & JP 10 200544 A (MATSUSHITA ELECTRIC WORKS LTD), 31 July 1998 (1998-07-31) abstract	1

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INTERNATIONAL SEARCH REPORT

Information on patent family members

Inter nal Application No
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